Standard Test Method for Creep of Rock Core Specimens in Triaxial Compression at Ambient or Elevated Tempertures[1]

This standard is issued under the fixed designation D 4406; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This test method covers the creep behavior of intact cylindrical rock core specimens' in triaxial compression. It specifies the apparatus, instrumentation, and procedures for determining the strain as a function of time under sustained load.

1.2 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D 6026.

1.2.1 The method used to specifiy how data are collected, calculated, or recorded in this standard is not directly related to the accuracy to which the data can be applied in design or other uses, or both. How one applies the results obtained using this standard is beyond its scope.

1.3 The values stated in SI units are to be regarded as the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific precautionary statements, see Section 7.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids

D 2113 Practice for Diamond Core Drilling for Site Investigation

D 2216 Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock

D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D 4341 Test Method for Creep of Cylindrical Hard Rock Core Specimens in Uniaxial Compression

D 4543 Practice for Preparing Rock Core Specimens and Determining Dimensional and Shape Tolerances

D 5079 Practices for Preserving and Transporting Rock Core Samples

D 6026 Practice for Using Significant Digits in Geotechnical Data

E 4 Practices for Load Verification of Testing Machines

E 122 Practice for Choice of Sample Size to Estimate a Measure of Quality for a Lot or Process

3. Terminology

3.1 Refer to Terminology D 653 for specific definitions.

4. Summary of Test Method

4.1 A section of rock core is cut to length, and the ends are machined flat to produce a cylindrical test specimen. The specimen is placed in a triaxial loading chamber, subjected to confining pressure, and, if required, heated to the desired test temperature. Axial load is rapidly applied to the specimen and sustained. Deformation is monitored as a function of elapsed time. Specimen deformation is monitored periodically.

5. Significance and Use

5.1 There are many underground structures that are created for permanent or long-term use. Often these structures are subjected to an approximately constant load. Creep tests provide quantitative parameters for stability analysis of these structures.

5.2 The deformation and strength properties of rock cores measured in the laboratory usually do not accurately reflect large-scale in situ properties, because the latter are strongly influenced by joints, faults, inhomogeneities, weakness planes, and other factors. Therefore, laboratory values for intact specimens must be employed with proper judgment in engineering applications.

NOTE 1—Notwithstanding the statements on precision and bias contained in this test method; the precision of this test method is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D 3740 are generally considered capable of competent and objective

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[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.12 on Rock Mechanics.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard.**

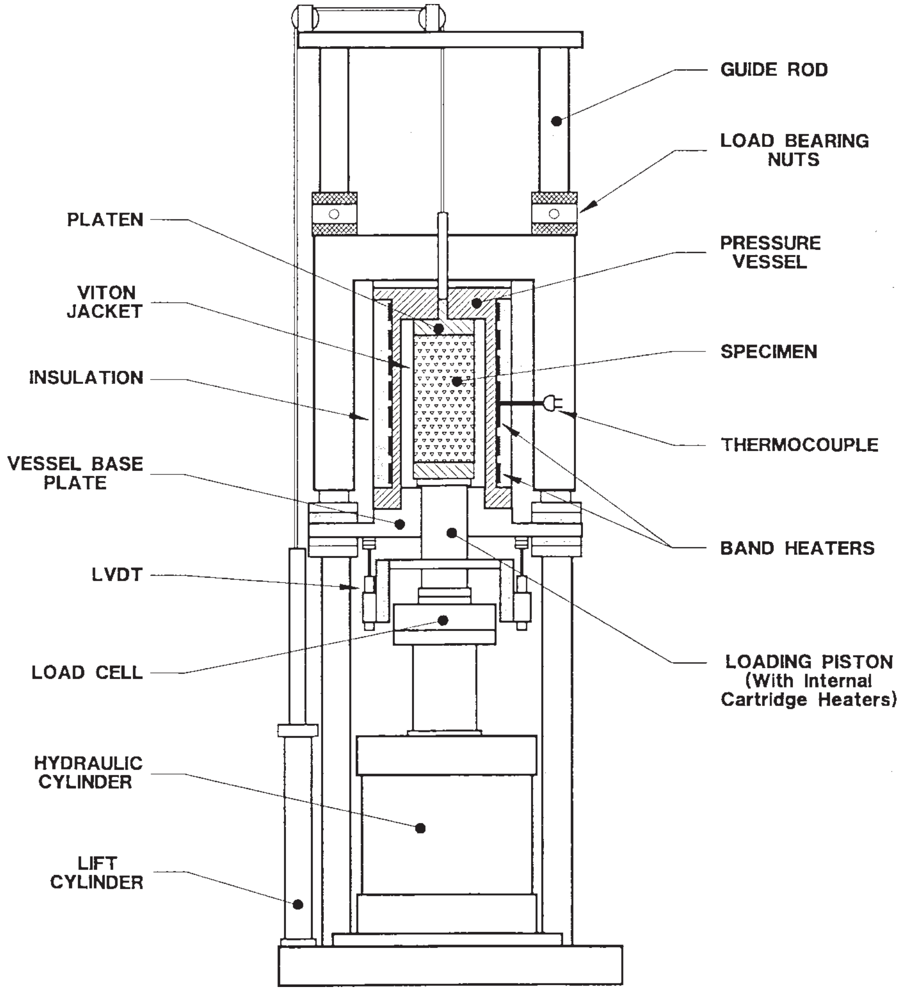

FIG. 1 Test Apparatus

testing. Users of this test method are cautioned that compliance with Practice D 3740 does not in itself assure reliable testing. Reliable testing depends on many factors; Practice D 3740 provides a means of evaluating some of these factors.

6. Apparatus

6.1 *Loading Device*—The loading device shall be of sufficient capacity to apply load at a rate conforming to the requirements specified in 10.6 and shall be able to maintain the specified load within 2 %. It shall be verified at suitable time intervals in accordance with the procedures given in Practices E 4 and comply with the requirements prescribed in this test method.

NOTE 2—By definition, creep is the time-dependent deformation under constant stress. The loading device is specified to maintain constant axial load and therefore, constant engineering stress. The true stress, however, decreases as the specimen deforms and the cross-sectional area increases. Because of the associated experimental ease, constant load testing is recommended. However, the procedure permits constant true-stress testing, provided that the applied load is increased with specimen deformation so that true stress is constant within 2 %.

6.2 *Triaxial Apparatus*—The triaxial apparatus shall consist of a chamber in which the test specimen may be subjected to a constant lateral fluid pressure and the required axial load. The apparatus shall have safety valves, suitable entry ports for filling the chamber, and associated hoses, gages, and valves as needed. Fig. 1 shows a typical test apparatus and associated equipment.

6.3 *Flexible Membrane*—This membrane encloses the rock specimen and extends over the platens to prevent penetration by the confining fluid. A sleeve of natural or synthetic rubber or plastic is satisfactory for room temperature tests; however, metal or high-temperature rubber jackets[3] are usually required for elevated temperature tests. The membrane shall be inert relative to the confining fluid and shall cover small pores in the sample without rupturing when confining pressure is applied. Plastic or silicone rubber coatings may be applied directly to the sample, provided these materials do not penetrate and strengthen the specimen. Care must be taken to form an effective seal where the platen and specimen meet. Membranes formed by coatings shall be subject to the same performance requirements as elastic sleeve membranes.

6.4 *Pressure-Maintaining Device*—A hydraulic pump, pressure intensifier, or other system of sufficient capacity to maintain constant the desired lateral pressure. The pressurization system shall be capable of maintaining the confining

[3] For example, viton.